

- ³ Department of Health and Social Security; Office of Population, Censuses, and Surveys; Welsh Office. *Hospital in-patient enquiry main tables 1978*. Series MB4 No 12. London: HMSO, 1981.
- ⁴ Ashley JSA, Collingwood J. *An investigation into the urological requirements for Great Britain*. Report to the British Association of Urological Surgeons. London: London School of Hygiene and Tropical Medicine, 1975.
- ⁵ Department of Health and Social Security; Office of Population, Censuses, and Surveys; Welsh Office. *Cancer statistics registrations 1978*. Series MB1 No 10. London: HMSO, 1982.
- ⁶ Department of Health and Social Security. *Hospital medical staff, England and Wales, regional tables R1-3*. Statistics and Research Division 1978. London: DHSS, 1982.
- ⁷ Dowie R. National trends in domiciliary consultations. *Br Med J* 1983; **286**:819-22.
- ⁸ Private Patients Plan. *Schedule of surgical operations and procedures*. London: Private Patients Plan, 1982.
- ⁹ North East Thames Regional Advisory Subcommittee in General Surgery. *Consultants in general surgery and urology*. London: North East Thames Regional Health Authority, 1983.
- ¹⁰ Butts MS, Williams DRR. Accuracy of hospital activity analysis data. *Br Med J* 1982; **285**:506-7.
- ¹¹ Whates PD, Birzgalis AR, Irving M. Accuracy of hospital activity analysis codes. *Br Med J* 1982; **284**:1857-8.
- ¹² Wyllie JH, Clark CG, Alexander-Williams J, et al. Effect of cimetidine on surgery for duodenal ulcer. *Lancet* 1981; **i**:1307-8.
- ¹³ Quill DS, Devlin HB, Plant JA, Denham KR, McNay RA, Morris D. Surgical operation rates: a twelve year experience in Stockton on Tees. *Ann R Coll Surg Eng* 1983; **65**:248-53.
- ¹⁴ Bengmark S. Die Ausbildung von Chirurgen in Schweden. In: Heberer G, Feifel G, eds. *Klinischer Unterricht und Weiterbildung in der Chirurgie*. Berlin: Springer-Verlag, 1978:123-41.

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Contemporary Themes

Control and prevention of tuberculosis: a code of practice

JOINT TUBERCULOSIS COMMITTEE OF THE BRITISH THORACIC SOCIETY*

Abstract

The Joint Tuberculosis Committee has compiled a report that is designed to answer the questions most commonly asked about the control and prevention of tuberculosis. Advice is given on assessing the degree of infectivity and on the segregation of patients. The measures necessary to protect National Health Service workers depend on the risk of exposure, and health authorities should follow the advice given by the Department of Health and Social Security. Chest x ray examinations may be recommended for those entering the teaching profession and may be necessary for staff and children when tuberculosis is discovered in a schoolchild. The diagnostic, protective, and therapeutic measures required for contacts depend on the degree of infectivity in the index case, the closeness of contact, and the ethnic group of the index case. The incidence of tuberculosis is much higher among some immigrant populations than among the native population and screening programmes are needed (a) to detect cases of active tuberculosis, (b) to identify infected individuals without active disease, and (c) to identify those in need of vaccination. Finally, the current recommendation that BCG vaccinations should be offered routinely in schools to children aged 10-14 has been highly effective in preventing tuberculosis and should be maintained.

Introduction

The Joint Tuberculosis Committee is receiving with increasing frequency inquiries about the control and prevention of tuber-

culosis. The need for information has resulted from the recent retirement of many physicians with experience in tuberculosis¹ and changes in staff during the current reorganisation of the National Health Service. Moreover, there are great differences in the incidence of tuberculosis between different regions of England and Wales² so that in some regions control and prevention of tuberculosis is a major concern of health workers, whereas in others the occasional case of tuberculosis poses an unfamiliar problem, giving rise to doubt and controversy.

The Joint Tuberculosis Committee has produced a report with the object of providing a code of practice incorporating the answers to questions that have arisen most often in regard to the control and prevention of tuberculosis.

Infectiousness and segregation of patients with tuberculosis

For practical purposes the only source of tuberculous infection is a person with pulmonary tuberculosis in whose sputum tubercle bacilli are present in sufficient numbers to be seen on direct examination of sputum smears. Patients with pulmonary tuberculosis in whom three or more sputum smears give negative results on direct smear examination, should be regarded as non-infectious (this includes patients whose sputum appears negative on direct examination but proves to be positive on culture).

Non-pulmonary tuberculosis is also non-infectious even though tubercle bacilli may have been cultured from specimens from the lesions.³ All patients diagnosed as having tuberculosis, whether infectious or not, must be notified as suffering from tuberculosis. Some problems of tuberculosis notifications have been reviewed recently by the Joint Tuberculosis Committee.⁴

Patients become non-infectious very soon after starting chemotherapy which includes rifampicin and long before the disappearance of acid fast bacilli from sputum smears. The number of live tubercle bacilli in sputum (as shown by growth in culture) falls by 99% after the first two weeks' chemotherapy.⁵ For practical purposes patients with pulmonary tuberculosis in whose sputum tubercle bacilli were seen on direct examination should be regarded as non-infectious after two weeks of chemotherapy including rifampicin but may not remain so unless regular and adequate chemotherapy is continued thereafter.⁶ This recommendation does not

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apply to patients in whom chemotherapy may be inadequate because of poor compliance or acquired drug resistance. Furthermore, a longer period of avoidance of contact may be recommended when close contacts include infants or young children. Details of rapidly effective chemotherapy regimens are given in recent publications.⁷

Control of tuberculosis in hospitals

The policy of admitting all patients with pulmonary tuberculosis to hospital for the purpose of treatment and segregation is now indefensible.⁸ Seven controlled studies have shown that therapeutic results of treatment in hospital are no better than those of well supervised home treatment.⁹ Home treatment exposes close family contacts to a negligible risk of infection, as has been shown by several controlled studies.¹⁰ The risk to contacts occurs before chemotherapy is started and is abolished rapidly thereafter. In spite of the absence of evidence of the value of hospital treatment, most patients with pulmonary tuberculosis in England and Wales are admitted to hospital for diagnosis, treatment, or segregation, or for social reasons.¹¹

Advice on the management of tuberculous patients in hospitals is given in the health circular of the Department of Health and Social Security (DHSS HC(78)3).³ When patients with newly diagnosed infection are treated in hospital special considerations apply because other patients in contact may be specially susceptible to infection because of lowered resistance due to illness or drugs. Segregation is therefore recommended for patients with pulmonary tuberculosis in whose sputum tubercle bacilli are found on direct smear. Segregation is maintained by accommodating the patient in a well ventilated single room or in a ward that has been set aside for patients with infectious tuberculosis. Barrier nursing is unnecessary; gowns and masks do not protect staff from infection and need not be worn. Patients should be instructed to cover their mouth and nose when coughing and sneezing, and those unable or unwilling to control coughs should wear a mask during nursing procedures. Marked crockery and separate washing up facilities are unnecessary, and no special precautions are needed for bed linen, books, etc, because transmission of tuberculosis is by droplet infection and not by foamites. Disposal of infectious material such as sputum or sinus discharge should be by heat sterilisation. Fumigation of rooms that have housed patients with tuberculosis is unnecessary. The cleaner of the room or ward housing infectious patients is not at special risk provided that he or she has been supervised in accordance with the recommendations made in the following section covering the protection of NHS employees against tuberculosis. Segregation can generally be discontinued two weeks after start of chemotherapy.

Patients with pulmonary tuberculosis whose sputum is negative on direct smear and patients with non-pulmonary disease do not need segregation and may be nursed in a general ward.

Protection against tuberculosis in NHS employees

All National Health Service workers likely to be in contact with patients or with tuberculous material should be subject to measures for protecting them against tuberculosis. Relevant advice is given in circulars for England and Wales³ and for Scotland.¹² Staff are divided into three groups according to their occupation. Those at minimal risk of exposure to tuberculosis who need no special protection and do not require pre-employment chest x ray examination, and those at normal or higher risk who need the protective measures described below. In addition, staff working with infants and children are screened to exclude those with infectious tuberculosis.

STAFF AT MINIMAL RISK

Employees at minimal risk are those in regular contact with patients and those laboratory workers and others who handle material that does not contain tubercle bacilli. Currently, the pre-employment examination includes a tuberculin test and chest x ray examination. Subsequent routine chest x ray examinations are unnecessary. The tuberculin test is best performed using the multiple puncture (Heaf) technique. The reading of this simple test gives a grading of the reaction (grades 1-4) according to the tuberculin sensitivity of the individual. BCG vaccination should be given to all those with negative and grade 1 reactions. No tests are required after vaccination. Any

person with a negative reaction who refuses vaccination should have the risks explained and the refusal recorded. They should be discouraged from engaging in any work that entails a risk of exposure to tuberculosis, and should be prevented from working in any of the high risk occupations mentioned below. They should be given a tuberculin test at six monthly intervals during their employment.

Staff who have received appropriate protection at the pre-employment examination and who are subsequently in contact with infectious tuberculosis run very little risk of developing the disease. They should be referred for the routine contact examination procedures mentioned below.

STAFF AT HIGHER RISK

Those at higher risk are staff who are in regular contact with patients known to have tuberculosis or laboratory workers who handle potentially tuberculous material.

These employees should have a pre-employment examination similar to that for staff at minimal risk but in addition all those given BCG vaccinations should have the site of vaccination inspected six weeks later to confirm that a satisfactory reaction has occurred; only those without such a reaction require a further test after vaccination. An annual chest x ray examination should be offered to all workers in the higher risk group.

STAFF IN OBSTETRIC OR CHILDREN'S DEPARTMENTS

All staff working in obstetric or children's departments should provide evidence of a satisfactory chest x ray film taken within the previous 12 months. This should include doctors, medical students, nurses, and ancillary workers. Difficulty may arise among trainee nurses and others who rotate through these departments for only short periods of time and who may have had a chest x ray examination within the previous few years and do not wish to have another because of worries about radiation. The risk to the recipient of a single x ray examination is negligible, however, compared with the risk of allowing infants and children to be exposed to infectious pulmonary tuberculosis.

Control of tuberculosis among school teachers and local authority staff

Candidates entering teacher training colleges should receive a tuberculin test and, if necessary, BCG vaccination. A chest x ray examination is no longer a mandatory part of the medical examination of school teachers on entry to the profession in England and Wales, but it may be advised at the discretion of the examining doctor¹³; it remains mandatory in Scotland.¹⁴ Local authority staff and others whose duties entail regular and close work with children are currently advised to have a pre-employment chest x ray examination or alternatively to provide evidence of a satisfactory x ray film taken during the previous 12 months. Routine periodic chest x ray examinations are not required, but staff who develop a respiratory illness with persistent cough should be referred promptly for a chest x ray examination.

Examination of contacts

A study of the examination of contacts in Britain showed that it is a necessary and valuable procedure.¹⁵ The figures quoted below are taken from this study.

DEFINITION OF THE TYPE OF CONTACT

Definition of the type of contact and of the disease and ethnic group of the index case is important in relation to the diagnostic, protective and therapeutic measures needed.

Pulmonary disease

Household and other close contacts—Contacts are at greatest risk when they share domestic accommodation with an index case in whose sputum tubercle bacilli are seen on direct examination. Some 9% of Asian household contacts and 12% of non-Asians develop active disease.¹⁵ Every effort should be made to identify all such

contacts. When the index case has sputum smears giving negative results on direct examination, household contacts run a much lower risk (2.8% of Asians and 0.5% non-Asians). They should, however, be examined.

Non-household and casual contacts—These contacts are not normally examined because they run a low risk (0.3%). If these contacts are unusually susceptible, however—for example, young children or immunosuppressed adults—or where the index case is thought to be highly infectious, examination of casual contacts may be desirable.

Non-pulmonary disease

Contacts of these patients run a low risk (1%). However the household contacts of an Asian index case should be examined.

INVESTIGATION OF CONTACTS

Investigation is by tuberculin testing and chest x ray examination.

Tuberculin testing is conveniently done by the Heaf multiple puncture method. The grading of the reaction (grade 1-4) according to the tuberculin sensitivity of the individual, is valuable in the selection of contacts for various management policies (see below). Alternatively, the Mantoux test may be used. The Tine test is convenient but its reliability has been questioned. Tuberculin testing is essential for all children who have not received BCG vaccination and is desirable for most contacts. It may be carried out immediately, but when the sputum of the index case shows tubercle bacilli on direct examination, it is best repeated more than six weeks from the last contact to allow time for tuberculin conversion.

Chest x ray examination is carried out on all adults and in tuberculin positive (Heaf grade 2-4) children.

MANAGEMENT

BCG vaccination is offered to Heaf grade 0 or 1 contacts unless they have been vaccinated previously.

Chemoprophylaxis may be considered for individuals who have a strongly positive reaction to the tuberculin test but who have no clinical or radiographic evidence of tuberculous disease. The risk of developing disease after infection depends on whether the individual has been recently infected, on age, and on ethnic group. Chemoprophylaxis is justified for contacts in whom tuberculin conversion is likely to have been recent. Chemoprophylaxis should be considered for all those up to the age of 15 years with grade 3 or 4 reactions to the Heaf test, for children up to the age of 5 years with grade 2 reaction, and for the contacts of an Asian index case with reaction of grades 2-4. Isoniazid should be used for chemoprophylaxis in a daily dose of 300 mg (5-10 mg/kg in children) for 6-12 months. The risk of isoniazid toxicity is minimal except in adults over 40 or alcoholics.

Follow up—Most disease in contacts is discovered during the initial examination and no further follow up will be required except for the following groups. (a) Those with grade 3 or 4 reaction to the Heaf test who are not given chemoprophylaxis should be followed up with chest x ray examinations for two years, provided that they have not had BCG vaccinations or previous tuberculosis. Those with grade 2 reactions (other than the groups mentioned above) require no follow up. (b) Household contacts of Asian index cases with pulmonary disease should be followed up with chest x ray examinations for 2 years, since in 14% of cases pulmonary disease is found by the end of the second year of follow up.

Tuberculosis in schools

Tuberculosis in schoolchildren or school staff may lead to alarm among parents and teachers and controversy among medical advisers. The following management is recommended.

Contact procedures are required only if the index case suffers from pulmonary tuberculosis. If the index case is a teacher or a child whose sputum is negative on direct examination, only the classmates need examination, but if the index case has sputum that is positive on direct examination, all children in the same year should be examined, so allowing for the mobility of the child in various classrooms, and all members of staff, if the index case is a teacher.

Contacts who have not had BCG vaccination—These children should undergo tuberculin tests. When the index case has positive findings on direct examination of sputum smears the tuberculin test should be repeated six weeks after the last contact with the case, so allowing

time for tuberculin conversion. Tuberculin reactors should be referred for chest x ray and contact examination (see above). Special care should be taken to examine all children who have not had BCG vaccinations, as there have been examples in which a single source of infection may cause disease in many of these susceptible children.

Contacts who have evidence of previous BCG vaccination—These children require a chest x ray examination, ideally about three months after the diagnosis of the index case.

Screening of immigrants

The incidence of tuberculosis among some immigrant groups in Britain is much higher than in the native born population. A survey in England and Wales in 1978/9 showed an overall annual notification rate per 100 000 of 18.3 but for the ethnic groups from the Indian subcontinent it was 382, with considerable regional variations, being 1132 in one region.² Screening programmes for immigrants have the following objectives¹⁶: (a) detection of active tuberculosis; (b) identification of infected (positive reaction to tuberculin test) individuals who have no evidence of active tuberculous disease, who may require chemoprophylaxis to prevent them developing the disease; and (c) identification of uninfected individuals (negative reaction to tuberculin test) who require BCG vaccination to prevent infection.

It is reasonable to screen all immigrants coming from countries where tuberculosis is common, especially those from the Indian subcontinent and the Vietnamese boat people, who have the highest tuberculosis rates.

ORGANISATION OF SCREENING

Over 80% of immigrants arrive in this country through terminal 3 at Heathrow, where they are referred to a medical officer who obtains the address of intended settlement, which is then reported to the relevant medical officer of environmental health. Information may also be obtained from family practitioner committees.

Immigrants should be contacted as soon as possible after arrival, as they are a highly mobile group. The maximum incidence of tuberculosis is within five years of arrival.¹⁷ This probably results most commonly from breakdown of apparently quiescent infection, so that if chemoprophylaxis is given, the earlier it is begun the better. If new high risk—that is, Asian—immigrants are expected in a community they can usually be handled by the already established tuberculosis contact clinics. If, however, the number is large, then a separate clinic with special staff may be needed. In this case efforts should be made to obtain the cooperation of immigrants through local immigrant organisations.

Screening procedures—Essential procedures are chest radiography, tuberculin test (Heaf multiple puncture), and BCG vaccination. Starting the process in the home is helpful for gaining immigrants' confidence and contacting as many of them as possible. It is therefore useful to have the Heaf test given and read at home, after which those with negative reactions are referred to a clinic for BCG vaccination, and those with positive reactions for chest x ray examination and assessment.

Chemoprophylaxis—Chemotherapy may be administered to individuals who give positive reactions to the tuberculin test but have no evidence of tuberculous disease; the object is to prevent them developing tuberculosis. The efficacy of chemoprophylaxis among immigrants in Britain can only be inferred but is probably high. The selection of people for chemotherapy is contentious. The incidence of clinical tuberculosis in immigrants from the Indian subcontinent during their first five years here is probably about 10%. Thus over five years 500 people would need to be treated to prevent 50 cases, assuming that chemoprophylaxis were 100% effective. It is therefore desirable to be selective in the use of chemoprophylaxis. It is generally agreed that chemoprophylaxis should be given to children under the age of 16 who have a positive reaction (grades 2-4) to the Heaf test but who have no evidence of previous BCG vaccination. Chemoprophylaxis for Asian immigrants over this age is a matter for discretion and is probably justified up to the age of 40. Chemoprophylaxis with isoniazid alone for 6-12 months is both cheap and effective but carries a considerable risk of poor compliance because of the long duration of treatment and the mobility of the population. Other regimens have been used for 3-6 months despite the absence of studies of the efficacy of these regimens.

The value of screening immigrants on their arrival may be ques-

tioned on the grounds that the yield of active disease is low and the value of chemoprophylaxis unestablished. Probably the greatest value is from BCG vaccination of children. The incidence of tuberculosis in children of parents from the Indian subcontinent compared with that of white children is 50 times greater if born abroad and 20 times greater if born in Britain.¹⁸ BCG vaccination should therefore be given at birth for those born in Britain and as soon as possible after arrival here for those born abroad.¹⁹

Screening by chest radiography before arrival in Britain is desirable, but as most disease becomes evident only after arrival in Britain, screening of high risk individuals would need to continue.

BCG vaccination

The DHSS currently recommends that BCG vaccination be offered routinely in schools to children aged 10-14 years throughout Britain, and this programme has been shown to be highly effective in preventing tuberculosis.²⁰ It is necessary for this policy to be maintained everywhere, including those regions that currently have a low prevalence of tuberculosis, as children living in these areas may subsequently go to work in regions where there is a much higher prevalence of tuberculosis, such as in London and the industrial cities of the Midlands, where the risk of infection is much greater than in the place of their schooling. Because of the mobility of the population BCG vaccination should not be abandoned until the risk of infection is low everywhere in Britain.

Before receiving BCG vaccination all children should receive tuberculin testing using the multiple puncture Heaf technique. Those with positive reactions (grades 2, 3 and 4) should be referred to the local chest clinic for examination and chest x ray. Those with grade 3 and 4 reactions merit follow up by chest x ray examination, and chemoprophylaxis may be given to Asian children. BCG vaccination is given to children who give negative or grade 1 reactions. The technique of BCG vaccination is described in a DHSS circular.²¹ The technique of administering a truly intradermal injection by needle and syringe is one that needs training and practice, and new staff should be trained by experienced operators to avoid injections that are subdermal instead of intradermal, which may cause local abscess formation.

References

- ¹ Citron KM, Lewis DR, Nunn AJ. Staffing in thoracic medicine. *Br Med J* 1980;281:887-8.

- ² Medical Research Council Tuberculosis and Chest Diseases Unit. The geographical distribution of tuberculosis notification in a national survey of England and Wales (1978-1979). *Tubercle* 1982;63:75-88.
- ³ Department of Health and Social Security. *Health service management control of tuberculosis in NHS employees*. London: DHSS, 1978:4. (Health circular HC(78)3.)
- ⁴ Joint Tuberculosis Committee of the British Thoracic Association. Notification of tuberculosis and code of practice for England and Wales. *Br Med J* 1982;284:1454-5.
- ⁵ Jindani A, Aber VR, Edwards A, Mitchison DA. The early bactericidal activity of drugs in patients with pulmonary tuberculosis. *Am Rev Respir Dis* 1980;121:939-49.
- ⁶ Rouillon A, Perdrizet S, Parrot R. Transmission of tubercle bacilli. The effects of chemotherapy. *Tubercle* 1976;57:275-99.
- ⁷ Citron KM, Girling DJ. Tuberculosis. In: Weatherall DJ, Ledingham JGG, Warrell DA, eds *Oxford Textbook of Medicine*. Oxford: Oxford University Press, 1983;5:237-62.
- ⁸ Editorial. Anonymous. Isolation of patients with pulmonary tuberculosis [Editorial]. *Br Med J* 1980;280:962-3.
- ⁹ Fox W. The modern management and therapy of pulmonary tuberculosis. *Proceedings of the Royal Society of Medicine* 1977;70:4-15.
- ¹⁰ Toman K. *Tuberculosis case-finding and chemotherapy. Questions and answers*. Geneva: World Health Organisation, 1979:219.
- ¹¹ Byfield SP, Citron KM, Derbyshire J, Fox W, Nunn AJ. Treatment of pulmonary tuberculosis in England and Wales. *Thorax* 1982;37:239.
- ¹² Scottish Home and Health Department. *Control of tuberculosis in NHS staff in Scotland*. Edinburgh: Scottish Home and Health Department, 1982. (SHHD Circular DS(82)40.)
- ¹³ Chief Medical Officer. Education Act 1980; education (teachers) regulations 1982. London: Department of Education and Science, 1982.
- ¹⁴ Scottish Education Department. Routine chest x-rays of teaching and social work staff. Edinburgh: Scottish Education Department, 1983. (Circular letter DSW/1983.)
- ¹⁵ British Thoracic and Tuberculosis Association. A study of a standardized contact procedure in tuberculosis. *Tubercle* 1978;59:245-59.
- ¹⁶ Joint Tuberculosis Committee. Tuberculosis among immigrants in Britain. *Br Med J* 1978;i:1038-40.
- ¹⁷ British Thoracic and Tuberculosis Association. Tuberculosis among immigrants related to length of residence in England and Wales. *Br Med J* 1975;iii:698-9.
- ¹⁸ Medical Research Council, Tuberculosis and Chest Diseases Unit. Tuberculosis in children in a national survey of notifications in England and Wales, 1978-1979. *Arch Dis Child* 1982;57:734-41.
- ¹⁹ Chief Medical Officer. *Control of tuberculosis in Britain*. London: DHSS, 1915 (Letter: CMO 27/65).
- ²⁰ Research Committee of The British Thoracic Association. Effectiveness of BCG vaccination in Great Britain. *Br J Dis Chest* 1980;74:215-27.
- ²¹ Department of Health and Social Security. *Immunisation against infectious disease. BCG*. London: DHSS, 1983.

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Clinical curio: addiction to sherbet fountains

Although modern confectionery is said to damage both the teeth and the digestion, reports of metabolic disturbances have been confined to liquorice abuse. We describe here a case of severe metabolic alkalosis after eating large quantities of sodium bicarbonate and liquorice in the form of sherbet fountains or lemon kali.

A 25 year old woman presented with a week's history of giddiness, slurring of speech, headache, and profound muscular weakness. She admitted to the ingestion of no drugs other than oral contraceptives. On initial examination she was slow mentally with slurred speech but no confusion or disorientation. Her blood pressure was 97/75 mm Hg. She had mild right sided cerebellar ataxia, profound muscle weakness, but no other abnormalities. Viral encephalitis or demyelination was tentatively diagnosed, but on admission considerable biochemical abnormalities were found: serum sodium concentration was 125 mmol(mEq)/l, potassium 1.5 mmol(mEq)/l, chloride 58 mmol(mEq)/l, urea 3.8 mmol/l (29 mg/100 ml), calcium 2.46 mmol/l (9.8 mg/100 ml), albumin 43 g/l, and glucose 4.8 mmol/l (86.5 mg/100 ml). Serum osmolality was 255 mosmol/kg and urine osmolality was 392 mosmol/kg. The urinary pH was alkaline at 9, and a midstream urine specimen was normal. Arterial blood gas estimation showed pH 7.6 (hydrogen ion concentration of 24.8), a normal arterial oxygen value of 13.3 kPa (100 mm Hg), a carbon dioxide value of 7.03 kPa (52.7 mm Hg), and a bicarbonate concentration of 82.8 mmol(mEq)/l. Urinary electrolytes showed a sodium of 60 mmol/l, potassium of 47 mmol/l and a urea of 9 mmol/l (0.05 g/100 ml). A Synacthen test was normal. This pronounced metabolic alkalosis, for which initially no cause was apparent, reverted to normal after treatment with intravenous physiological saline for

24 hours. After direct questioning she admitted to being passionately fond of lemon sherbet, often eating up to eight Barrett's sherbet fountains a day as well as buying lemon kali powder. Indeed, for the first 48 hours of her hospital admission her father had been bringing her in half pound bags of lemon kali powder. After we explained the hazards all her biochemical measurements reverted to normal, and she returned to good health.

Metabolic alkalosis induced by amounts of sodium bicarbonate is unusual, and there was no evidence of excessive gastric loss of chloride due to vomiting,¹ deficient chloride intake,¹ or excess of renal retention of bicarbonate as shown by a urinary pH of 9.^{2,3} There was no evidence of intrinsic renal disease, and she had not been taking diuretics.

Biochemical analysis of a random sample of Barrett's sherbet fountain showed a hollow stick of liquorice weighing 6 g and a yellow sweet effervescent powder weighing 22 g. We presume that it is a mixture of sucrose, sodium bicarbonate, and either citric or tartaric acid. A 1% solution of the powder was of pH 5.2 and contained 9 mmol/l of bicarbonate, 7 mmol/l of sodium, but no potassium. Its osmolality was 38 mosmol/kg. A variable but considerable bicarbonate load² under the influence of the aldosterone like effect of excess liquorice ingestion produced a kaliuresis and a consequent complex metabolic alkalosis with hypokalaemia probably explained her cerebellar dysfunction and muscle weakness.—G KAYE, senior house officer, and E R WILLIAMS, consultant physician, Coventry.

- ¹ Sabatini S, Arruda JA, Kurtzman NA. Disorders of acid base balance. *Med Clin North Am* 1978;62:1223-55.
- ² Van Goidsenhoven GM-T, Gray OV, Price AV, Sanderson PH. Effect of prolonged administration of H_2CO_3 in man. *Clin Sci* 1954;13:383.
- ³ Gonzalez J, Hogg RJ. Metabolic alkalosis secondary to baking soda treatment of diaper rash. *Pediatrics* 1981;67:820-2.